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THE MINOAN PEAK SANCTUARY LANDSCAPE THROUGH A GIS APPROACH

1. INTRODUCTION

The main goals are to identify the peak sanctuary characteristics, combining archaeological features with environmental variables in the Minoan landscape, and to create a model to understand the role of the peak sanctuary in this landscape.

The characteristics of the peak sanctuary, its history, and interpretations, known from the published bibliography are summarized below.

1.1 *Definition*

Within the broad spectrum of Minoan site types, one group stands out for its specific topographical location: the peak sanctuaries. Peak sanctuaries are characterized by their closeness to mountain peaks (Fig. 1) and a specific cult apparatus (RUTKOWSKI 1988, 73-98; PEATFIELD 1990, 117-119; NOWICKI 1994, 33-35).

Most commonly found are animal and human figurines, pottery and often a pebble scatter. The peak sanctuary can also display ash layers, architectural remains, bronze, and Linear A inscriptions, which are characteristic for the peak sanctuary's second historical acme, the neopalatial period.

Quite some confusion exists on the actual identification of the peak sanctuaries, due to the limited publication on many of the sites, which is why this project chose to include both positively identified sanctuaries and candidate sites.

Both Nowicki and Peatfield excluded most of the candidates, because the archaeological evidence alone was not sufficient to identify them as peak sanctuaries.

Sites that only produced many figurines, and had no relation with a mountain peak were disqualified, but other sites, located near peaks with archaeological evidence (usually unpublished, wrongly dated or not further specified), were not excluded. After all, many peak sanctuaries have been looted and destroyed by army, church, and antenna constructions, bad weather and soil erosion.

A GIS approach however can add further environmental variables, common for all of the sites, to compensate for the lack of archaeological evidence. The absence of certain archaeological features does not mean they were never there.

1.2 Chronology

The chronological sequence of peak sanctuaries' history is not very well known due to limited publication based mostly on rescue excavations. Only Petsofas, Iuktas and Atsipades Korakias were excavated more systematically and they were published more extensively¹.

It is argued by Peatfield that the peak sanctuaries originate from prepalatial burial sites (PEATFIELD 1987, 89-90). The idea of the peak sanctuary probably spread through the whole island of Crete during EM III-MMI (2300/2150-1900BC) (PEATFIELD 1990, 124-127; PEATFIELD 1994a, 23). All known peak sanctuaries were in full use from MMIB-II (1900-1800BC) on, a period that corresponds with the First Palace period (protopalatial). These sanctuaries have regional material and are of a rural character. During MMIIIA (1650BC) or the Early Second Palace period (neopalatial) most of the regional peak sanctuaries were abandoned and only 8 sanctuaries remained. They display much richer material and often impressive architectural structures (PEATFIELD 1987, 92; NOWICKI 1994, 41). This phenomenon has been explained as the centralization of state-controlled religion (PEATFIELD 1990, 126-130). In MMIIIB-LMI (1600-1480/1425BC) the remaining peak sanctuaries were equally abandoned with the sole exception of the most impressive, largest and richest peak sanctuary of all, Iuktas.

1.3 Distribution

There are about 60 sites under study of which 23 have been positively identified as peak sanctuaries (RUTKOWSKI 1988; NOWICKI 1994, 47; PEATFIELD 1990, 117-119).

In the protopalatial period, a dense concentration of sanctuaries existed in east Crete in comparison to the rest of Crete. We observe a more hierarchical distribution of a peak sanctuary "network" in central Crete, and three more intervisible sanctuaries in the Rethymnon prefecture. In the neopalatial period, the distribution of the palatial peak sanctuaries, which revealed luxury goods and architecture, seems to be related to the "palatial centres" (PEATFIELD 1987, 89-93). Only three of the east Cretan and one west Cretan peak sanctuaries remain in use, while central Crete displays a similar distribution in both periods.

1.4 Interpretation

As can be deduced from the artefact assemblage, these sites were used for offering, sacrifice, processions, and initiation rites, with the intention to

¹ PEATFIELD 1994b, 14 peak sanctuaries have been excavated, only three extensively published; Petsofas: RUTKOWSKI 1991, *passim*; Iuktas: KARETSOU 1974, 1975, 1976, 1977, 1978, 1980, 1981a, 1981b, 1984a, 1984b, 1985, *et al.*; Atsipadhes: PEATFIELD 1992; MORRIS, PEATFIELD 1995; NOWICKI 1994, 41-42; PEATFIELD 1991, 1992b, 1993, 1994c, 1995, 1996.



Fig. 1 – Prinias peak sanctuary.

protect the health of human, faunal and floral life (RUTKOWSKI 1991, 52-57; PEATFIELD 1992, 74-80).

The peak sanctuary has also been identified as a landmark because of the unique shape of the mountain and its location in the landscape (Fig. 1). The possible presence of thick ash layers (indicating bonfires), intervisibility and elevation even suggested the use of peak sanctuaries as a network of sacred beacons (PEATFIELD 1983, 277). A more practical function of such a network could indicate long distance communication or even control over the visible area. These interpretations have promising features in a GIS analysis.

They have also been interpreted as astronomical observation centres (FAURE 1969, 190; 1972, 392: on remarkable orientations; HENRIKSSON, BLOMBERG 1996, 99-114), from which solstices, equinoxes, moon, sun and star movements could be observed. The religious character of the site, does not contradict any of the above interpretations.

2. A GIS APPROACH

The reconstruction of the peak sanctuary landscape was based on the highly accurate mapping of them with GPS receivers. The resulting coordinates were then projected on a SPOT generated Digital Elevation Model (DEM) of Crete.

If a GIS approach to this subject is to be successful, we need to implement a broad spectrum of data, and analyse these data statistically, so that



Fig. 2 – 3D representation of the DEM.

they can be used as possible variables for the identification of peak sanctuary locations. So far, a variety of maps has been digitised, including topographical data, the coastline, caves and quarries, geological formations, faults, land use and land capability.

A 50×50m accuracy DEM has been generated by stereoscopic SPOT images and it has been presented in 3D (three-dimensional) and in a fly-through mode (Fig. 2).

To avoid environmental determinism (GAFFNEY, VAN LEUSEN 1995, 367-382; KVAMME 1997, 1-5) a database with the known Minoan cultural information was created. It contains major protopalatial and neopalatial settlements, palaces, harbours, production centres, guard posts, other sanctuaries and cemeteries.

At this point only data of the definitely identified peak sanctuaries have been used in the following analyses.

Using the DEM the visibility of any point on the map can be tested. This means that we can verify the communication and controlling capacities of the peak sanctuaries. These visibility tests are called “viewshed analysis” (WHEATLEY 1995, 171-186).

Two cumulative viewsheds from the peak sanctuaries are here presented, displaying the protopalatial and neopalatial landscape. The focus on the Cretan inland was achieved by draping a binary raster to hide the sea.

2.1 *Protopalatial viewshed*

The most obvious observation in the protopalatial Cretan landscape is the density of the resulting viewshed coverage and the distribution of peak sanctuaries in the eastern part of the island, in contrast to the absence of any major site or peak sanctuary in the west (Tav. IVa).

It has been argued by Nowicki that protopalatial Crete was divided in three big peak sanctuary zones, namely a dense network of similar sized sites in the Sitia area, a central zone, with Iuktas as main landmark, controlling the valleys of Pediada, Mesara and Temenos and a third triangle in the Rethymnon district (NOWICKI 1991, 143-145). The settlement pattern itself of various areas of Crete seems to have evolved differently, both in terms of

density, and in terms of hierarchy (DRIESSEN 2001, in press). This might explain the variability of peak sanctuary distribution.

Especially in the east we can observe that in the protopalatial period there are more peak sanctuaries than important settlements, confirming that they probably belonged to rural and sometimes isolated nucleated settlement groups. In the protopalatial period hierarchy of settlements in central Crete seems already highly tiered, with Knossos, Phaistos and Mallia at the top level. The intervisibility of Iuktas and Kofinas with their satellite peak sanctuaries displays a similar hierarchy. The absence of any major sites in the Rethymnon area will hopefully be clarified with the Agios Vasilios Survey (MOODY *et al.* 1996, 359-371; BLACKMAN 1997-98, 120-121; 1998-99, 123; 1999-2000, 148), and the excavations at Chamalevri (TOMLINSON 1989-90, 78; 1993-94, 84; 1994-95, 72; BLACKMAN 1996-97, 120; 1997-98, 123-24; 1998-99, 123; 1999-2000, 148), which are still in process.

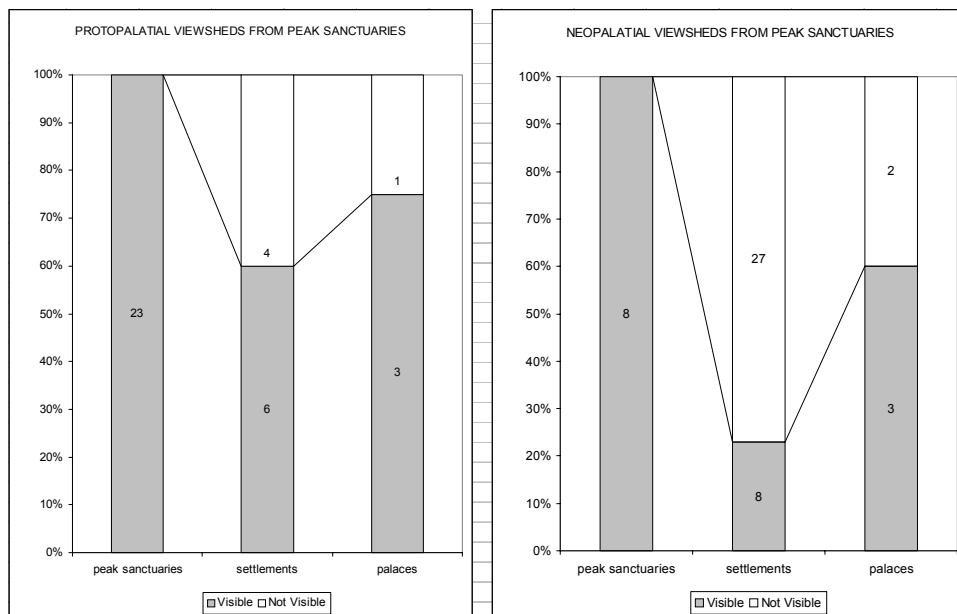
Statistical analysis of the viewsheds of protopalatial peak sanctuaries is rather a rough approach, as numbers of sites are not really representing the protopalatial settlement pattern, but the pattern of important excavated and surveyed sites. It does not reflect the regional differences either. Yet some general remarks can be made, based on the balance between visible and not visible sites. Peak sanctuaries have 100% intervisibility, 6 out of 10 settlements are visible, and 3 out of 4 palaces have visible contact with the peak sanctuaries (Graph 1). The palace of Mallia seems to have been in opposition to the peak sanctuary idea (NOWICKI 1991, 145). The peak sanctuary of Karfi might be close, but is not visible.

2.2 Neopalatial viewshed

The visible landscape from the neopalatial peak sanctuaries shows an evolutionary process (Tav. IVb). Visibility is generally lower, three out of eight peak sanctuaries are isolated from the others and each peak sanctuary seems to belong to at least one major site. The isolated peak sanctuaries are Prinias (Petras-Agios Georgios), Petsofas (Palaikastro Roussolakos) and Vrysinas (Chamalevri?). The Traostalos (Kato Zakro) – Petsofas link appears to be weak. A good optical network remains in Central Crete with Iuktas (Knossos, Archanes) in the centre surrounded by Kofinas (Phaistos, Kannia), Pyrgos (Tylissos), Filiorimos (?), and possibly Megalos Rozitis Lilianou (Galatas, Kastelli).

Statistical analysis of the above viewsheds confirms the centralization theory² (Graph 1). Optical link between the palaces and the peak sanctuaries

² PEATFIELD 1990, 126-130. In the concluding remarks of a previous report (SOETENS *et al.* 2002), we stated decentralization as a hypothetical explanation of the decrease in number of peak sanctuaries. The reinvestigation of this theme confirmed however centralization of religion in the neopalatial period.



Graph. 1 – Comparison of visibility from protopalatial and neopalatial peak sanctuaries to settlements and palaces.

remains relatively stable, whereas only the more important settlements are visible from the peak sanctuaries. The intervisibility between the peak sanctuaries, almost restricted to central Crete, confirms the distinct role of Iuktas, which is still visible from 3 other peak sanctuaries, and further supports the idea of centralization of religion, more specifically, centralization towards Iuktas, not surprisingly the largest and richest of the peak sanctuaries.

2.3 Landmarks - beacons

The relationship between the sea and peak sanctuaries became apparent after removing the binary raster mask (Tav. Vc). The extent of coverage of the cumulative viewshed is impressive. The function of the peak sanctuaries as landmarks for travellers or even as beacons for incoming ships appears as an attractive and logical hypothesis, especially when we consider the presence of either sea or river pebbles, and the possible presence of ash layers³.

³ PEATFIELD 1990, 119; further viewshed analysis investigating the visibility of peak sanctuaries from around the island, in SOETENS *et al.* 2002.

2.4 Topographical characteristics

Topographical characteristics of the peak sanctuaries such as the elevation, aspect and slope will be studied through processing of the DEM, both on the micro-scale of the peak sanctuary itself, as on the scale of the peak sanctuary's influence region. Further environmental characteristics, such as geological formations, land use and land capability will be analysed through a joining of the peak sanctuaries' locations with the respective maps (SOETENS *et al.* 2002).

3. CONCLUDING REMARKS

The archaeological background to the peak sanctuaries was briefly introduced, with a comment on their problematic identification, chronology and interpretation. The sites were revisited and their location was determined with high accuracy by GPS receivers. The broader geomorphologic context of the sanctuaries was acquired by digitisation techniques and image processing of SPOT satellite images. Even in this preliminary stage, viewshed analysis proved to be a valuable asset in a GIS approach. The high intervisibility of the peak sanctuaries was not only confirmed, but it turns out that all protopalatial peak sanctuaries were intervisible, and this level of intervisibility centralizes towards Iuktas in the neopalatial period, leaving Vrysinas, Prinias and Petsofas isolated.

The relation of peak sanctuaries with settlements and palaces showed a clear evolutionary pattern between proto and neopalatial periods, confirming the centralisation of a possibly state-controlled religion. The scale of research enabled us to capture the peak sanctuaries as one phenomenon for the island of Crete and the sea around it, suggesting another function for the peak sanctuaries. Further GIS and multivariate statistical analysis will refine the model, determine the environmental and topographical characteristics, and finally it will clarify even more the function and meaning of the peak sanctuary on the scale of its surrounding and contemporary sites, its relation with the Minoan palaces and the Bronze Age Aegean.

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ABSTRACT

The research project, “Building a cultural landscape model of Minoan peak sanctuaries through a GIS approach”, based on the collaboration between the Institute of Mediterranean Studies (F.O.R.T.H.) and the Université Catholique de Louvain, aims to redefine the peak sanctuary, clarify its function, and examine the relation between the cultural and natural variables, which characterize the distribution of these sites in the Cretan landscape.

To accomplish these goals we used advanced mapping techniques, satellite remote sensing, statistical analysis and Geographical Information Systems (GIS). Intervisibility is investigated with viewshed analysis. A chronological evolution of the peak sanctuary landscape is proposed, explaining the location of the sanctuaries, in relation to each other and other site types.